

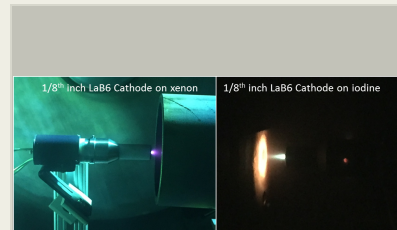
Ultra-Compact Center-Mounted Hollow Cathodes for Hall Effect Thrusters, Phase I

Completed Technology Project (2017 - 2017)



Project Introduction

The proposed innovation is a long lifetime, compact hollow cathode that can be mounted along the axis of a 600 W-class Hall effect thruster. Testing at kilowatt power levels and above has shown that the thruster axis is the optimal position for thruster throttling and plume divergence. It also minimizes the impact of background conditions upon ground based performance measurements, reducing programmatic and technical risk to the end user. The proposed compact cathode will extend these benefits to low power Hall thrusters. The cathode will be compatible with iodine as well as with noble gases. Hollow cathodes are a critical, life-limiting component for Hall effect thrusters and gridded ion engines. Failure mechanisms include degradation, poisoning and evaporation of the electron emitter, keeper and emitter tube orifice erosion, and heater failure. To achieve >10,000 hr lifetime, compact cathode will use a hexaboride (LaB6 or CeB6) electron emitter. Hexaborides degrade more slowly than state-of-the-art barium oxide impregnated tungsten emitters at equivalent current densities. Hexaborides are also resistant to contamination from oxygen and other impurities. The cathode also includes a new, high temperature heater. To minimize keeper and orifice erosion, the design will be optimized through testing and plasma measurements. In Phase I, Busek shall design, built and test the compact cathode. The plasma plume will be interrogated with an emissive probe to determine spot and plume mode operating regimes on xenon and iodine. An integrated cathode-thruster test will also be performed to determine the cathode's performance with a thruster. The Phase II test program will include duration testing of the cathode and thruster-cathode system with a fully modified BHT-600, thermal cycling and plasma modeling. At the end of Phase II a cathode will be delivered to NASA for testing with a 600W-class Hall thruster.



Ultra-Compact Center-Mounted Hollow Cathodes for Hall Effect Thrusters, Phase I Briefing Chart Image

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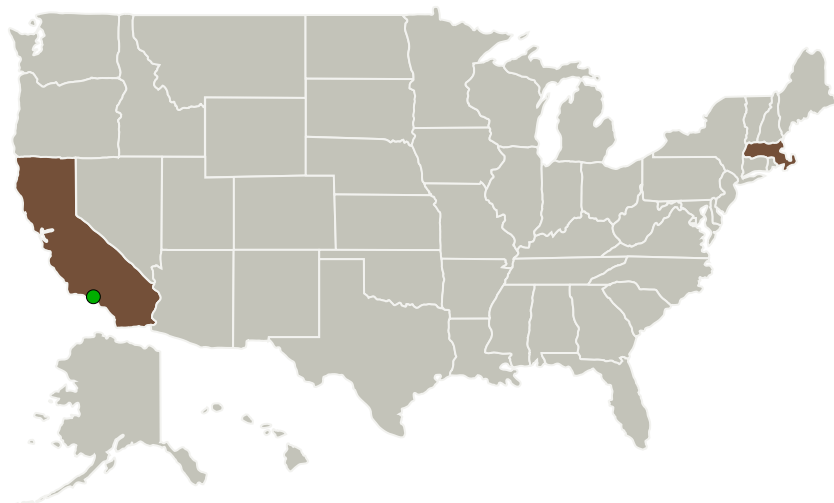
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
● Jet Propulsion Laboratory (JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

**June 2017:** Project Start**December 2017:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139508>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

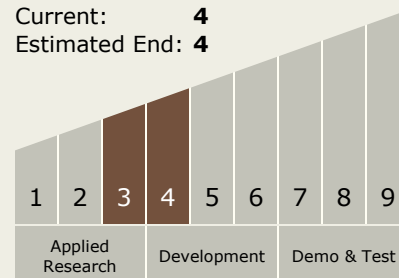
Carlos Torrez

Principal Investigator:

Zachary Taillefer

Technology Maturity (TRL)

Start: **3**
 Current: **4**
 Estimated End: **4**

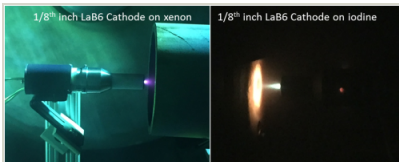


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Images



Briefing Chart Image

Ultra-Compact Center-Mounted
Hollow Cathodes for Hall Effect
Thrusters, Phase I Briefing Chart
Image

(<https://techport.nasa.gov/image/134411>)

Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.2 Electric Space Propulsion
 - └ TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon,
Mars, Others Inside the Solar
System, Outside the Solar
System